

NON-PUBLIC?: N
ACCESSION #: 9001090077
LICENSEE EVENT REPORT (LER)

FACILITY NAME: LaSalle County Station Unit 2 PAGE: 1 OF 10

DOCKET NUMBER: 05000374

TITLE: Spurious Reactor Protection System Actuation Due to Unknown Cause

EVENT DATE: 08/26/89 LER #: 89-011-01 REPORT DATE: 01/04/90

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 010

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: John C. Klika, Assistant Technical TELEPHONE: (815) 357-6761
Staff Supervisor, extension 2533

COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: JC COMPONENT: RLY MANUFACTURER: G082
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On August 26, 1989, a controlled shutdown was in progress on Unit 2. While conducting LOS-TG-SA2, "Turbine Valve Leak Tightness surveillance," a Reactor Protection System (RPS) actuation occurred at 0414 hours. When the actuation signal was received, two of the four scram group lights of the RPS Bus A remained energized. This prevented some of the rods from receiving the normal automatic scram actuation. Rod motion appears to have initiated for these rods due to the Channel A backup scram actuation which occurred at the same time as the initial event. The Control Room Operator manually initiated a normal scram signal a few seconds later using the A2 and B2 scram pushbuttons. At this time all the remaining scram valves deenergized, indicating that the scram had occurred.

Before the turbine valve test was started, the Hathaway Sequence of Events alarm typer was turned off due to its constant printing caused by

alarm relay chattering. As a result, the main source of information to be used in analyzing the reactor trip was not available. At the time of the trip, no plant parameters exceeded their trip setpoints.

As a result of the missing information, several scenarios were developed using available information in an attempt to determine the cause of the reactor trip. At this time a definite cause for the trip has not been determined. The investigations have concluded that a very brief (less than 15 milliseconds) disturbance in the RPS system allowed some of the scram contactors to trip, but was not present long enough to ensure all the contactors tripped. The source of this spurious signal is unknown.

This event is reportable in accordance with 10CFR50.73(a)(2)(iv) due to the actuation of an Engineered Safety Feature System.

END OF ABSTRACT

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PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor

Energy Industry Identification System (EIIS) codes are identified in the text as XX!.

A. CONDITION PRIOR TO EVENT

Unit(s): 2 Event Date: 8/26/89 Event Time: 0414 Hours
Reactor Mode(s): 1 Mode(s) Name: Run Power Level(s): 10%

B. DESCRIPTION OF EVENT

On August 26, 1989 a controlled shutdown was in progress on Unit 2 in preparation for a maintenance outage to replace the seal on the 2B Reactor Recirculation (RR) AD! pump. In accordance with the General Surveillance schedule, LaSalle Operating Surveillance LOS-TG-SA1, "Turbine semi-annual Overspeed Surveillance," had just been completed satisfactorily. At 0336 hours, LOS-TG-SA2, "Turbine Valve Tightness test," was begun.

After successful completion of the Turbine Control Valve leak tightness portion of LOS-TG-SA2 at approximately 0412 hours, an Equipment Operator (EO) installed a jumper on the 02 Main Turbine Stop Valve (KSV 2) pre-amp function board in the Electro-Hydraulic Control (EHC) JG! cabinet. This causes the Main Turbine Stop

Valves to go closed while maintaining the Turbine Control Valves open. This started the Turbine Stop Valve portion of the LOS-TG-SA2.

After the jumper was installed, MSV 2 began to drift closed as expected. When MSV 2 reached 90% open position, MSV 1, 3 and 4 closed reaching full closed at 0413 hours.

Approximately 23 seconds after MSV 1, 3 and 4 reached full closed, at least one subchannel in each of Reactor Protection System (RPS) JC! channels A and B tripped, with the respective channel trips occurring within 40 milliseconds of each other. At this time only the "A" back-up scram channel energized. (Refer to Attachment A.)

After the automatic RPS actuation, the Control Room Operator (NSO, licensed Reactor Operator) performing the surveillance noticed that the A2/A3 rod scram group lights were still energized which indicated that the A2 and A3 control rod scram solenoids were still energized. He directed another NSO at the feedwater pump panel to manually scram the reactor. This NSO armed and depressed the A2 and B2 subchannel manual scram pushbuttons. This scram occurred approximately 12 seconds after the automatic actuation. This action successfully deenergized the A2 and A3 scram solenoids (and rod scram group lights) and caused the B channel of the back-up scram to energize (by deenergizing the "K14G scram contactor). All rods were verified to be fully inserted within a minute of the initial signals. It is estimated that rod groups 1 and 4 were fully inserted 3 seconds after the initial actuation and all

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B. DESCRIPTION OF EVENT (Continued)

control rods were fully inserted within 3 seconds of the manual scram. Based on available indications, it was determined that all other expected automatic actions occurred as expected after a valid process scram signal had not occurred. This event is being reported in accordance with 10CFR50.73(l)(2)(iv) due to the actuation of an Engineered Safety Feature System.

Prior to performing the Turbine Valve Tightness Test the turbine was tripped at 0306 and 0319 hours on August 26, 1989. The reactor did not scram during either of these events because the 30% Turbine First Stage Pressure Trip Bypass was in effect at the time.

From approximately 2327 hours on August 25, 1989 to 0316 hours on

August 26, 1989, the sequential memory of the sequence of events recorder (SER) was being saturated (filled) due to cycling inputs from the B Turbine Driven Feed Water Pump Seal Injection Pressure switch, and the Off-Gas Pre-Treatment Radiation Monitor Low Sample Flow detector. Both of these alarms are "normal" for the shutdown condition, and were cycling rapidly because the process signals were slowly passing through the alarm setpoints.

At about 0338 hours the Hathaway Sequential Events Recorder (SER) alarm printer was turned off because the typer was continuously printing messages caused by these nuisance alarms. This printing was distracting to the Operators who were performing the turbine valve surveillance in the immediate vicinity of the typer. This had no effect on the operation of the visual or audible alarms in the Control Room. Authorization to bypass these alarms had been initiated prior to when the printer was turned off and had just been obtained just prior to the event, but the associated bypass jumpers had not been installed.

As a result of not having the SER alarm printer in operation at the time of the event, investigations into the cause of the event are very difficult. Therefore the primary sources of recorded data for this event are the plant process computer (CX) IDI, the Startrec computer and Control Room charts. The process computer prints out certain digital inputs if they change state for at least 1 second (its digital point scan rate). It also printed a "NSSS post trip log" which prints a historical log of 10 analog sensor readings (stored at 5 second intervals) retrieved from 5 minutes prior to its initiation. This log was initiated by the receipt of the "A" backup scram signal which accompanied the initial automatic scram. The Startrec recording was initiated directly by the RPS actuation and records selected signals from .5 seconds before the trip to 1 minute after the trip. It has a scan rate of 20 milliseconds per scan.

C. APPARENT CAUSE OF EVENT

To evaluate the cause of the scram, a list of possible scram signals was generated and available information (including Control Room chart recorder data) was used to eliminate any parameters which it could be shown to have not exceeded their scram setpoints (LSSS value) at any time. The results of this comparison concluded that there is no indication that any LSSS parameter actually reached a required scram setpoint. Therefore, any RPS channels which received trip signals were receiving only false trip indication, not reflective of the true process conditions.

C. APPARENT CAUSE Of EVENT (continued)

Extensive Operator interviews were conducted. The only significant information related to the cause of the event was the Operator actions to verify that the visual annunciator system "first out" light lit was the "Turbine Stop Valves Not F-Open" alarm. This alarm is expected during the associated test and would not necessarily reflect the cause of the scram in this case. This contributed to the Operators' belief that the scram had been caused by a combination of the stop valve closure (due to the test), and an unexpected loss of the scram bypass function which operates off of the turbine first stage pressure. Subsequent indications of the turbine first stage pressure led to the conclusion that this was not likely to be the cause of the scram signal.

Further investigations indicate that the scram signal could be due to a spurious pulse (not caused by an actual process variable transient) on one of the sensing lines which is shared by an "A" and a "B" RPS subchannel. All shared sensing lines were identified using plant drawings.

Extensive tests of the RPS system was undertaken in an attempt to detect anomalies in the following areas:

- 1) proper subchannel wiring (i.e., that the correct contactors respond to trip and reset actuations,
- 2) inadvertent or failed rest/seal-in paths,
- 3) loose connections,
- 4) foreign materials inside the contactors or housings,
- 5) response timing between paired contactors and between contacts on the same contactor,
- 6) logic inputs (station scram functional surveillances performed),
- 7) Radio - frequency interference, and
- 8) mechanically induced trips due to striking common sensing lines.

All of these tests demonstrated proper operation in all "A" and "B" RPS channels.

The failure of the A2 and A3 Reactor Protection System channels to drop out indicates that the K14E and K14G scram contactors did not trip. Scram contactors K14E and K14G were removed from the plant to be tested. Prior to removal the following was performed:

- 1) Visual checks for discoloration
- 2) Drop out timing tests
- 3) Response times
- 4) Coil and contact resistance

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C. APPARENT CAUSE OF EVENT (Continued)

- 5) Varistor current check
- 6) Coil shorted turns test
- 7) Temperature rise test

Early evaluations indicated that the pulse which initiated the trip signal was sufficiently short and the reaction time of the contactor(s) was slow enough to prevent drop-out and seal-out of one contactor in a logic pair.

Extensive testing was done by System Operational Analysis Department (SOAD), with vendor and NRC observers to look for abnormalities in the removed K14E and K14G contactors and in a new contactor. This testing has found no identifiable problem with the K14E or K14G contactor. However the testing demonstrated a repeatable condition where narrow pulse actuations (between 8 and 12 milliseconds) will occasionally result in one contactor in the pair dropping out and the other remaining energized.

The initiation of the event could not have been a valid scram signal. The studies done show that the observed operation of the RPS system was not the result of mechanical binding but could be mimicked by applying trip signals for short (8 to 12 milliseconds) intervals. Such signals were observed to cause only one of the two relays in the RPS automatic scram channel to actuate (de-energize and stay de-energized).

The most plausible explanation of this event is that it was initiated by a spurious signal having a duration of 8 to 12

milliseconds. Because not all plant monitoring equipment was available at the time, the exact source of this spurious signal cannot be determined.

The manual scram was a valid scram signal and performed as expected and designed.

D. SAFETY ANALYSIS OF EVENT

Initiation of the event was not due to an actual transient on a parameter which is monitored to protect the reactor. All systems, when required to operate, functioned as designed.

The delay in the operation of these contactors caused the insertion delay of two groups of rods. Insertion of two rod groups is sufficient to ensure the reactor is subcritical in hot shutdown.

Reviews of the computer scan of rod positions which was requested at the time of the scram indicated that all rods were being inserted. This shows that the actuations of the "A" backup scram channel was sufficient to cause the scram air header to bleed down enough to open the scram valves of the last two groups of rods and cause them to begin moving before the Operator manually scrammed the reactor.

This event is not expected to have been worse at higher power levels since no actual plant transient occurred during the event.

Due to the redundancy of the Reactor Protection System components and the satisfactory response of required support systems, the safety consequences of this event are minimal.

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E. CORRECTIVE ACTIONS

The Operating Department generated procedure guidance to prevent the deactivation of key recording devices while major evolutions are in progress and delay the start of major evolutions until these recording devices were operable. LaSalle Administrative Procedure LAP-1600-2, "Conduct of Operations," has been revised with the following guidance:

- 1) The SER alarm typer will not be turned off during evolutions that have a high potential for an unexpected transient.

2) Provide options which can be used to deal with nuisance alarms.

In addition, the importance of the SER in post event evolutions has been included in Operator training. Options for improving the availability of the SER will be pursued tracked by Action Item Record (AIR) 374-200-89-03701.

Response time tests were conducted on these scram contactors in an attempt to identify faulty contactor and/or quantify the magnitude of their response times. During the test equipment hookup to the A1 subchannel, the partial scram condition appeared to be repeated only once in many attempts, where the A2 and A3 lights did not deenergize as quickly as did the A1 and A4 lights. This trip signal was generated while setting up the monitoring instruments and, though it was observed by personnel in the Control Room, was not recorded. Subsequent attempts to repeat the event at varying times failed to repeat the unusual dropout behavior of the suspected "E" contactor or identify its cause. Because of this second observation of similar behavior as the initial scram and the repeated successful tests on the "G" contactor, the "E" contactor was considered to be suspect. As a conservative measure, both the K14E and K14G contactors have been replaced. The two removed contactors have been sent to Commonwealth Edison's System Operational Analysis Department (SOAD) to be analyzed for potential failure mechanisms.

The SOAD testing and inspection of the removed contactors consisted of 4 phases. These were:

1. Detailed inspection of "as found" conditions prior to removal.
2. Preliminary non-destructive response time characteristics testing of the contactor and associated varistor (voltage spike suppressor).
3. Disassembly and inspection with vendor and NRC observation.
4. Reassembly and testing of response times under varied trip demand conditions.

Phase 1 discovered the presence of fire retardant cable packing which had vibrated out of the conduit entering the top of the contactor housing. This was not considered to be related to the problem under evaluation.

E. CORRECTIVE ACTIONS (Continued)

Phase 2 demonstrated that it was possible to deenergize a single contactor in a pair if the demand "pulse" is short enough, between 8 and 12 milliseconds.

Phase 3 discovered no unusual conditions inside the contactor moving assembly or contacts. All movable surfaces were free of foreign material which could cause binding or sticking, and no physical distortion of any parts was found. The above mentioned packing material was present inside the contactor body, in small quantities. This dry, soft material was not seen to potentially interfere with contactor movement. No contact welding was indicated.

Phase 4 involved detailed simulation of the plant logic chain. Dropout tests of the parallel contactors was performed using the same relay contact configuration as the plant. (Phase 1 tests had used a solid state switching device to drop out the contactors.) In this way, random portions of the AC waveform would be interrupted by the driving relay contacts, and the possible effect of contact bounce could be simulated. This testing showed that narrow pulses to the logic chain which result in interruption of AC power to scram contactor for intervals of 8 to 15 milliseconds would result in a single contactor dropping out approximately once in 70 to 80 demands. The width of this interval is consistent with all observed information to date.

On September 8, 1989 following the performance of LaSalle Instrument Surveillance LIS-NR-402, "Intermediate Range Monitor Rod Block and Reactor Scram Functional Test" on the D Intermediate Range Monitor (IRM) IG!, the D IRM function switch was moved from OPERATE to TRIP TEST and back to OPERATE with the INOP INHIBIT button depressed. (This bypasses the inoperative scram signal.) This was done to verify proper operations but was not part of LIS-NR-402. During this action the RPS subchannel was reset (which is not the case during the normal LIS). When the mode switch was moved from TRIP TEST to OPERATE, a HI-HI signal was generated for a short period. RPS rod groups B2 and B3 were dropped but B1 and B4 did not trip. Investigations did not find any specific problems with the system.

During the investigation it was learned that the channel C and D Turbine First Stage Pressure switches were found to be out of tolerance in the non-conservative direction due to instrument drift. This did not affect the sequence of events. Deviation report (1-2-89-039) has been

generated on these switches and they have since been recalibrated.

Corrective actions have been taken to correct specific equipment operational problems. These have been done under LaSalle Work Requests, and were reviewed in accordance with a special On-Site Review for plant startup.

The RPS specific corrective actions are as follows:

1. Scram contactors K14E and K14G were replaced.
2. The turbine valve leak tightness testing was satisfactorily performed on Unit 2 startup to verify that the event is not repeated as a result of testing.

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E. CORRECTIVE ACTIONS (Continued)

3. Recording instrumentation was installed to monitor the RPS channels during the subsequent startup of Unit 2, until the next refuel.

F. PREVIOUS EVENTS

None.

G. COMPONENT FAILURE DATA

Manufacturer Nomenclature Model Number MFG Part Number

General Electric Scram CR-105 CR105D02
Contactor CR105X100E

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Figure "Attachment A, Reactor Protection System" omitted.

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Figure "Attachment B, RPS Logic Example LaSalle" omitted.

ATTACHMENT 1 TO 9001090077 PAGE 1 OF 1

Commonwealth Edison

LaSalle County Nuclear Station
Rural Route #1, Box 220
Marseilles, Illinois 61341
Telephone 815/357-6761

January 4, 1990

Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D.C. 20555

Dear sir:

Licensee Event Report #89-011-01, Docket #050-374 is being submitted to your office to supercede previously submitted Licensee Event Report 89-011.

G. J. Dierich
Station Manager
LaSalle County Station

GJD/TAH/bjp

Enclosure

xc: Nuclear Licensing Administrator
NRC Resident Inspector
NRC Region III Administrator
INPO - Records Center

*** END OF DOCUMENT ***
